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Economic pressures have always been a tremendous incentive to minimize waste and maximize production. The authors suggest that a joint industry/EPA program be set up to accomplish this, and offer some suggestions on areas in which to start.

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# WASTE MINIMIZATION INSIGHTS FOR THE POLYMER INDUSTRY

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# WASTE MINIMIZATION: INSIGHTS FOR THE POLYMER INDUSTRY


## Abstract

The huge volumes of polymeric materials produced in this country can also result in the production of large volumes of wastes consisting of "off spec" polymers, process solvents, additives, stabilizers, and gaseous emissions. The EPA has recently instituted an effort to work with the industry to minimize these wastes, which will not only result in lower pollution, but, if properly thoughtout and instituted, result in cost savings to the industry.

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# WASTE MINIMIZATION INSIGHTS FOR THE POLYMER INDUSTRY

The objective of this paper is to make the polymer production segment of the chemical industry aware of EPA's waste minimization program, how industry and EPA might work together, and offer some suggestions about areas of research into innovative ways of eliminating or minimizing wastes produced in plastic materials production. In addition, we would like to solicit ideas for new research projects; these projects may be financed by EPA, by industry, or jointly.

A waste minimization research program was launched by the Environmental Protection Agency (EPA) in 1987, resulting in the creation of an Agency-wide Pollution Prevention Office in 1988. The primary goal of this Office was to promote an integrated approach across all media regarding pollution prevention by minimizing the amounts of wastes generated at the various sources.

The term "pollution prevention" is used here in its broadest sense, referring to the reduction or elimination of pollutant discharges to the air, water, or land. Pollution prevention approaches include:

Reducing the quantity and/or toxicity of pollutants generated by production processes through source reduction, waste minimization, and process modification

Eliminating pollutants by substituting non polluting chemicals or products (e.g., material substitution, changes in product specifications, etc.).

Recycling of waste materials (e.g., reuse or reclamation).

The EPA has explored various technical, economic, and policy issues relevant to the reduction and recycling of hazardous wastes. A report to Congress concluded that it would be counterproductive for EPA to establish a mandatory program for waste minimization at this time. First, mandatory programs would "second guess" industry's production decisions and quite possibly produce counterproductive results. Second, mandatory programs would be difficult to design and administer. Third, generators already face strong economic incentives to reduce their wastes. In addition, a regulatory program would take time to develop, and many industries might postpone any action until mandatory requirements are defined.

In its efforts to pursue the objectives of the waste minimization program, a five element approach has been established, as listed below.

1) Promoting waste reduction by transferring technical information to firms and state and local governments.

2) Encouraging the adoption of waste reduction by identifying, evaluating, and demonstrating appropriate technologies, and by promoting the use of waste minimization assessments.

3) Keeping Congress advised on national progress on waste minimization.

4) Fostering development of state and local government waste minimization programs.

5) Developing outreach and communication programs with the goal of raising awareness of the benefits of waste minimization within government, industry, and the public.

Element (2) above forms the basis for the Waste Reduction Innovative Technology Evaluation (WRITE) Program which is designed to identify, evaluate, and/or demonstrate new ideas and technologies that lead to waste minimization.

The basic elements of a waste minimization program shown in Figure 1 may be applied to the polymer manufacturing industry and to the chemical industry as a whole. They could be summed up by saying "adhere to good operating practices." Many of these practices would appear to be obvious to an experienced operating person in the industry, but they bear repeating, and asking oneself if the plant is <u>really</u> operated as efficiently as it could be by minimizing releases, and recovering and recycling wherever possible. As a beginning, the following items could be considered.

1) Schedule production runs so as to minimize cleanups and heels. Examples of this could be to schedule batches of resin so that ones having closely similar specifications follow one another; in many instances cleanup between batches can be eliminated. Low density polyethylene runs could be made in cycles starting with the lowest melt index grades, and progressing upwards in melt viscosity (downwards in melt index). This procedure greatly lessens the amount of purge resin required between grade changes.

2) In process quality control must start at the earliest stages of production. Rigid control at every step of polymerization and compounding, including minimizing purging losses by developing new analytical or measuring procedures will minimize waste and help to maximize profits.

3) Consider the benefits of changing to a distributed control system. These systems have become so sophisticated that they can operate a process better than even the most experienced technician.

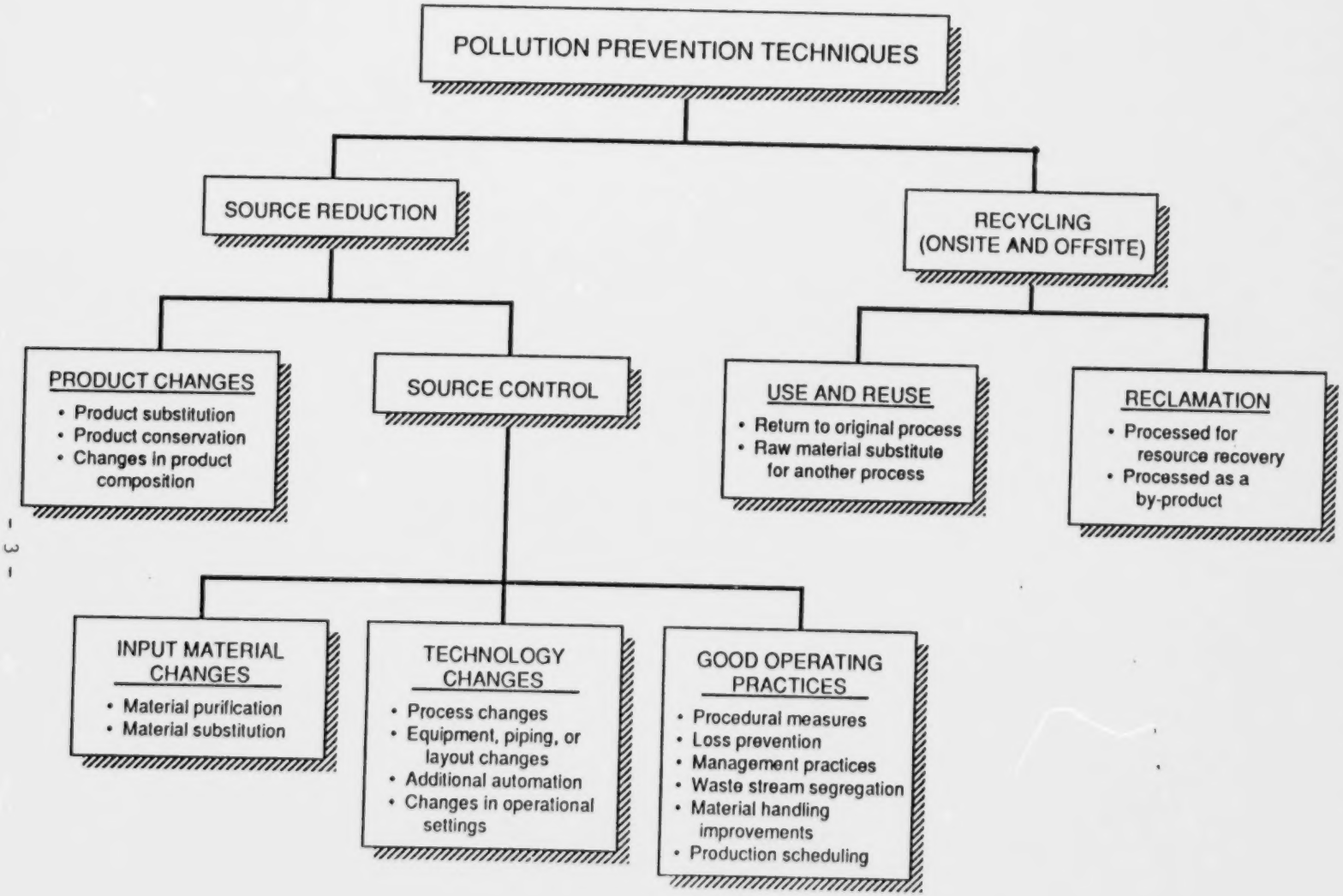


Figure 1. Waste reduction techniques

4) Set high standards for maintenance personnel by checking that no valves, flanges, or pump and agitator seals are leaking. Set up a preventative maintence program for these and other potential loss sources.

5) Remember, minimizing waste and losses is one of the situations where everyone wins. Profits are maximized, workers are healthier, neighbors are happier, and future generations will not have to live with the pollution we have left behind.

A few examples of waste minimization operations now being carried out in the industry, and some suggestions for research programs are offered for consideration.

Nylons

Process changes made at the Du Pont Victoria, TX plant have cut wastewater volumes from the adiponitrile unit by 50%, while improving product yields. (1)

Both Du Pont and Monsanto are offering a dibasic acid by product of adipic acid for use in slurry scrubbers for flue gas desulfurization. (1), (2).

Vinyls

Unreacted vinyl chloride monomer (VCM) may be vacuum or steam stripped from polymerization reactors, and recovered together with emissions from storage tank vents and resin dryers. Several recovery systems have been used, such as absorbing in a solvent (3) or a comonomer (4). Absorbing will easily remove 99+% of the monomer, which may be stripped from the absorbent and returned to the process. Refrigerated condensers can be used for VCM, but are generally less effective because of its high vapor pressure. Refrigerated condensers are widely used on storage tank vents and reactors to capture higher boiling monomers for reuse. Activated carbon adsorption is another possibility, but steam regeneration is generally required, followed by hot air drying of the bed.

Phenolics

Perhaps the largest source of waste in the manufacture of phenolic resins is the wastewater from the condensation reaction. Common practice is to take this water off as a vapor, condense it, and send it to a water treatment facility; this puts an extra load on the biological process, risks killing off the "bugs", and wastes a valuable raw material. The solubility of phenol in organic solvents is sufficiently high that it may be extracted, the solvent stripped off for reuse, and the phenol recycled to the process. A potentially useful recovery process would utilize low pressure composite reverse osmosis (RO) membranes (5). The water/phenol solution could be pumped through the RO unit as condensed, but better and faster separation will result if the pH is raised to about 11.

Polyolefins

Although the production of this class of resins is generally considered to produce very little waste, the volumes produced indicate that there are areas where waste reduction would be of great benefit. The following items should be considered:

A. Solids

Spills of pellets and powder are ordinarily washed into the sewer, ending up in the sludge pond. Installing a skimmer to separate this material could yield a salable product at least equal in quality to some recycled material. "Drool" and purge resins can likewise be recovered. At this time there appears to be very little use for high pressure separator wax. A program to find a market for this material, such as crosslinking and blending into asphalt, could be of benefit.

B. Liquids

Spills of reaction solvents such as hexane and isobutane are commonly flushed into the oily waste sewer. These solvents could be recovered by steam stripping, for example, and sent to a recycler.

C. Vapors

Ethylene and propylene vapors are very difficult to capture or control. A recently announced molecular sieve is said to capture ethylene and other hydrocarbon vapors (5). Ducts or piping from valves, seals, etc. is sent to the recovery unit instead of a flare. The developer states that the cost of the unit may be recovered in 4-5 years.

We have attempted to present a number of processes which could be used to minimize waste in polymer production, many of which are in use at various facilities. Corporations, states, or universities who may be interested in cooperating with EPA on innovative waste minimization projects are urged to submit proposals for review. These projects maybe carried out either at the proposers facilities, or, under the new Stevenson - Wydler Act, Federal laboratories that are available under certain circumstances.

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